

INTRODUCTION

1.1 Name of Developer

Mopani Copper Mines Plc

1.2 Address of Developer

Mopani Copper Mines Plc
Corporate Office
Nkana West
Corner of Central Street and 5th Avenue
P. O. Box 22000
Kitwe, Zambia

1.3 Telephone Number of Developer

+260 2 247000/247002

1.4 Fax Number and Electronic Mail Address

+260 2 220725

mopani@mopani.com.zm

1.5 Name of Owner of Mine

Mopani Copper Mines Plc, Comprising The Following:

<u>Name</u>	<u>Shareholding</u>
Glencore International AG	73.1%
First Quantum Minerals Plc	16.9%
Zambia Consolidated Copper Mines Investment Holdings	10%

1.6 Mine Manager or the Person Responsible for the Mine

Mr. Nikolas Rhodes

Tel. +260 2 441001

E-mail: nrhodes@mopani.com.zm

1.7 Prospecting Permit or Mining Rights or Licence Number

Large Scale Mining Licence, Registration No. LML 32 (Appendix A)

2.0 LEGISLATION

The Environmental Impact Assessment Regulations, 1997, Part II, issued under the Environmental Protection and Pollution Control Act No. 12 of 1990, Part XII (96) and the Mines and Minerals (Environmental) Regulations, 1997, Part II, issued under the Mines and Minerals Act No. 31 of 1995, Part IX (75), both require that before a developer commences implementing a project, an environmental project brief, is prepared and submitted to the relevant regulatory agency for review and approval.

The Environmental Impact Assessment Regulations, 1997, at part II (3)(2), specifically require that a developer prepares and submits a project brief for:

- (a) any project categorised under any of the project types listed in the First Schedule, whether or not the development is a part of a previously approved project; or
- (b) any alterations or extensions of any existing project which is set out in the First Schedule; or
- (c) any project which is not specified in the First Schedule, but for which the Council determines a project brief should be prepared.

The Mines and Minerals (Environmental) Regulations, 1997, at part II (3)(6) specifies as follows with respect to an environmental project brief:

The project brief shall contain information set out in the First Schedule to which shall be attached:

- a brief statement on the impact of the prospecting, exploration or mining operations on the environment and;
- information on any remedial action, if any, to be implemented and complied with.

This project brief has therefore been prepared to satisfy the above regulatory requirements. It includes preliminary predictions of possible significant impacts on the environment that will be generated at the various stages of the project phases together with the appropriate remedial action plans to mitigate the impacts.

Further, it is envisaged that since this project is a project within a project, for which a global environmental impact statement does exist, this environmental project brief will suffice for the purposes of regulatory policing and appraisal of this project, until its inclusion in the global environmental impact statement (EIS), when the EIS is reviewed and updated at a later stage as required by legislation.

3.0 PROJECT DESCRIPTION

3.1 Introduction

On the basis of completed technical and engineering studies and the internal reviews of all available and relevant information, the Smelter Upgrade Project has been defined as the upgrading of the Mufulira Smelter to a treatment capacity of 850,000 tpa of concentrates by the replacement of the existing electric smelting furnace with a high-intensity Isasmelt smelting furnace. In summary, the project will include the following elements:

(a) Upgrading of the concentrate storage and handling area, to accommodate the higher throughput and ensure consistent and reliable furnace feed blending and conditioning.

(b) Installation of an Isasmelt furnace and ancillaries capable of initially treating 650,000 tpa of concentrate at moderate oxygen enrichment of approximately 55%, increasing to 850,000 tpa at higher oxygen enrichment of approximately 70% with no additional capital requirement.

(c) Installation of an MCM owned cryogenic oxygen plant to supply tonnage oxygen to the Isasmelt furnace. The plant will be built with an installed capacity of 650 tonnes per day (tpd). However only 500 tpd will be required at the 650,000 tpa concentrate treatment rate.

(d) Installation of a purpose designed matte settling electric furnace (MSEF) capable of handling the production of matte / slag from the Isasmelt furnace and return slag from the Peirce-Smith converters at the 850,000 tpa concentrate treatment rate and producing a discard slag of <0.7%Cu for disposal at the slag dump.

(e) Phased upgrading of the converting and anode casting areas to accommodate the initial 650,000 tpa and the subsequent increase to 850,000 tpa in concentrate throughput.

(f) Installation of a single contact sulphuric acid plant to treat ~80,000 Nm³/hr of 9-16%SO₂ tenor process offgas produced in the Isasmelt furnace for the production of 98.5% sulphuric acid.

(g) Upgrading of plant services including power reticulation and infrastructure to support the above levels of plant throughputs.

3.2 Materials Handling

The Isasmelt process is a high intensity, low residence time smelting process. It is an important operating requirement for the concentrate to be consistently blended to ensure stable process control and for the product matte quality to be maintained within acceptable limits.

The existing concentrate storage shed will be expanded to allow blending of approximately 30,000 tonnes of concentrate in three 10,000 tonnes stockpiles using overhead conveyors system and front end loaders. Conveyor to a surge bin will deliver the pre-blended concentrates. Bins will also be installed for reverts, recycle dust, coal and fluxes.

The feed mix (including the coal and fluxes) will be conveyed by the collector conveyor to a twin shaft paddle mixer where water will be added to produce a mixed feed containing approximately 10% moisture. The conditioned feed will be conveyed to the Isasmelt building and will pass onto the final feed conveyor, located above the Isasmelt furnace. The final feed conveyor will be a movable, reversible conveyor to allow bypassing of the Isasmelt furnace for maintenance duties and to prevent heat damage to the belt during shutdowns. The feed mix will be charged from the final feed conveyor through the feed port in the furnace roof and fall into the molten bath below.

As indicated above, the materials handling system required for the Isasmelt furnace will not require the concentrate to be pre-dried to <1% moisture as is the case with the existing electric furnace. This will result in the heavy fuel oil (HFO) fired concentrate drier being de-commissioned with significant environmental benefits through the elimination of both fugitive and stack emissions of dust from the drier.

3.3 Isasmelt Furnace

The Isasmelt furnace, to be installed within the existing smelter plant, is a vertical cylinder (cover picture), supported on a concrete base. The steel shell will be approximately 5.4 m internal diameter and 12.6 m high and be lined with 450 mm chrome-magnesite refractory bricks. The roof of the furnace will be constructed from boiler tube sections containing ports for feed addition, lance insertion and offgas removal.

The lance for the Isasmelt furnace will be of stainless steel, about 15 m long with a diameter of 350 mm. The lance design has been developed to operate with a lance air supply from a centrifugal blower.

Tonnage oxygen (95% purity) supplied by the new oxygen plant will be sparged into the process air line prior to the inlet to the lance. Final trim temperature control of the bath will be effected by adjustments to the air /

oxygen ratio or through the use of a small oil flow down the lance. Fuel oil will also be injected down the lance to heat up the bath on start up following Isasmelt furnace maintenance shutdowns.

The depth of lance immersion in the molten slag bath will be controlled automatically by the distributed control system (DCS). The control logic will ensure that the lance tip is always at the optimum position in the bath. This procedure will ensure a lance tip life of typically 5-10 days. Lance changes will normally be carried out during routine or other plant maintenance stoppages and will take about 45 minutes. Lance repairs will involve cutting off the worn tip and replacing it with a new section (up to 1m length) of new stainless steel.

A fuel oil / air holding burner will be used to maintain the furnace temperature during maintenance shutdowns. A dedicated fan will supply the combustion air to the burner. The fuel oil flow and air flowrates will be controlled by the DCS automatically. The burner will not be required during normal operations but the combustion air fan will instead be used to supply air to the top of the furnace through the slag box to ensure efficient post combustion of unburnt coal volatiles.

Matte and slag produced by reaction of the raw materials with the process air / oxygen will be tapped intermittently using a tapping machine (combined drill and mud gun) through the single water-cooled tapping block located at the bottom of the vertical brick section. The mixed matte / slag will flow along a specially designed water-cooled copper launder into a purpose designed Matte Settling Electric Furnace (MSEF) for settling into separate copper matte and slag phases, after which matte will be advanced to the converters for further processing while the slag will be skimmed, granulated and discarded at the slag dump.

The offgas from the Isasmelt furnace will pass into a radiation channel section of a waste heat boiler. This vertical section will quench the gas to below 850°C. The radiation section will be supplied with hammers to dislodge any accretions, which may form on the walls, so that they can fall back into the

molten bath. At the top of the radiation channel, the gas will turn through 180 degrees and travel down into an evaporative gas cooler, in which water sprays will quench the offgas to a temperature suitable for entry into an electrostatic precipitator (ESP) at approximately 350°C. The gases will subsequently pass through an ESP and induced draft (ID) fan and finally into the acid plant.

Secondary ventilation hooding will be installed at the Isasmelt feed chute, Isasmelt lance port, Isasmelt tapping ports, MSEF matte tapping ports and the MSEF slag tapping ports. The combined secondary ventilation flumes will be collected and discharged at elevation. The sulphur dioxide and dust contained within the secondary ventilation system is insignificant compared to the primary ventilation system, however they are collected to improve the operator environment.

The Isasmelt furnace design has been based on a matte grade of 64% copper, which is consistent with existing Isasmelt operations around the world. At 64% matte grade, 98,000 tonnes and 110,000 tonnes of gaseous sulphur dioxide will be captured in the acid plant for the 650,000 tpa and 850,000 tpa concentrate treatment respectively. Total smelter sulphur dioxide emissions will be 80,000 and 113,000 tonnes for the 650,000 tpa and 850,000 tpa concentrate treatment rates respectively. However the matte grade will probably be progressively increased to 70% copper, at the 650,000 tpa stage, to take advantage of the full acid plant capacity. Increasing the matte grade to 70% copper will increase the sulphur captured to 104,000 tpa and thereby reduce sulphur emissions to 73,000 tpa. However it should be noted that operation of the Isasmelt furnace at 70% copper matte grade is unproven at industrial scale and will require a more thorough evaluation before implementation.

Compared to the current scenario of operating the electric furnace at a concentrate treatment rate of 430,000 tpa, the operation of the Isasmelt furnace in conjunction with an acid plant for fixation of the furnace off gas sulphur dioxide will result in a net total reduction in emissions of 18% when

operating at 650,000 tpa. Should it be feasible to operate at 70% copper matte grade, then the net reduction in emissions would increase to 28%. Sulphur dioxide capture at the 850,000 tpa treatment rate will be subjected to a regional acid market study so as to establish the viability for increasing acid production through the fixation of converters offgas.

Dust from the evaporative gas cooler and electrostatic precipitator will be routed to the Isasmelt furnace feed blending area and recycled to the furnace.

Depending on the quantity of minor elements in the feed (e.g. arsenic) some of the collected dust may be bled from the recycle stream for alternative treatment to prevent accumulation of minor elements in the dust and hence in the smelter products.

3.4 Oxygen Plant

The Isasmelt furnace requires a supply of tonnage oxygen to achieve its design capability. Mass balances provided by the Isasmelt technology supplier, Xstrata Technology, indicate that for the initial throughput of 650,000 tpa of concentrates, a supply of about 500 tpd oxygen of 95% purity is required and at a throughput of 850,000 tpa the oxygen requirement increases to 650 tpd.

Tonnage oxygen for the Isasmelt furnace will be supplied from a cryogenic oxygen plant, which will concentrate atmospheric oxygen by separating it from the other constituents of atmospheric air through the use of low temperature distillation.

This will be achieved through the following main processes:

- (a) Compression
- (b) Purification and cooling to liquid air temperature
- (c) Separation by low temperature distillation
- (d) Re-warming of separated components

3.5 Matte Settling Furnace

The requirement for the purpose designed Matte Settling Electric Furnace (MSEF) is to be capable of handling the production of matte / slag from the Isasmelt furnace at the 850,000 tpa concentrate treatment rate and the slag from the Pierce-Smith (PS) converter furnaces to produce a discard slag of <0.7wt%Cu;

The matte settling electric furnace plant design capacity will be for processing a cumulative 150 tph feed at the 850,000 tpa concentrate treatment rate. A 'turn-down' potential will be required to operate at a cumulative 106 tph feed at the 650,000 tpa concentrate treatment rate.

The furnace will be rated at 12 MVA and will use 1,069 mm Soderberg electrodes. The estimated power requirement for the normal matte settling operation is 8 MW. The furnace power will be increased during the converter slag feed to promote mixing and help prevent the formation of an intermediate magnetite layer between the matte and slag. Power will then be reduced to optimise the matte / slag settling prior to slag tapping. Seals on the electrodes will minimise the escape of furnace fugitive gases. The electrode seals will also protect the electrodes from continuous exposure to furnace gases and heat.

The furnace bath size will be determined from the volumetric requirements of the furnace settling capacity rather than from the electrical power input. The furnace will be sized to hold a matte heel of up to 400 tonnes which will enable the converter operation to be de-coupled from the Isasmelt furnace.

A smelting balance has indicated that a small amount of reductant material will need to be added to the matte-settling furnace to reduce the magnetite present in the slag from the Isasmelt furnace and the return converter slag. Six coke bins will be constructed above the furnace to feed coke to the furnace.

Converter slag will be returned to the MSEF in ladles at times that are dependent on the converter blowing cycle. The converter slag return launder will be constructed of refractory, with a spoon-shaped end to receive the slag from a ladle. The slag feed launder opening will be closed by means of a gate when no converter slag is being charged into the furnace to eliminate fugitive emissions.

The MSEF furnace will have two slag and four matte tapholes. The tapholes will be refractory lined steel shells.

From the MSEF, copper matte will be tapped into ladles and taken to the converters for further processing. Slag will be tapped and allowed to flow down a launder to the slag granulation pit. The granulated slag will be retrieved from a granulation pit using a retractable bucket elevator arrangement or an overhead grab crane and conveyed to surge bins from where it will be loaded into road trucks for off-site disposal at the existing slag dumps. The composition of the MSEF discard slag will be similar to that currently being discharged from the electric furnace.

Water used for slag granulation will be recycled to process and only make up water added to replenish losses to the atmosphere through evaporation. A similar closed loop system will apply for taphole cooling water.

Offgases from the MSEF will be vented at elevation through a dedicate stack. The sulphur dioxide and dust content is insignificant.

3.6 Converters and Anode Casting Sections

The capacity of the Mufulira Smelter converting furnaces will be expanded to allow for processing of the additional matte produced in the Isasmelt furnace at the increased concentrate treatment rates. In addition, there will be a requirement to install a holding or surge facility for the blister copper produced in the converter furnaces prior to transferring to the anode furnaces for fire refining and casting.

At the 650,000 tpa concentrate treatment rate, matte production will be approximately 1,200 tpd. In order to accommodate the required number of converter blows to process the matte, a total of three 'hot' converters will be required on-line at any one time, with another converter on 'cold' stand-by. Currently there are four installed converters that have capacity to process the increased matte production of 1,200 tpd although in their current configuration there would be no contingency for any reduction in converter utilization e.g. due to premature failure of converter refractory. To allow for the increase in matte production from the Isasmelt furnace and to have sufficient redundancy to compensate for any reduction in converter utilization, the four existing converters will be dimensionally expanded (longitudinally) to increase their productivity. This expansion will be carried out during the normal three-monthly scheduled maintenance shutdown for each converter.

Should an additional overhead crane be required to handle the additional material movements, a disused crane currently idle in the converter main aisle will be refurbished and brought on line.

There is adequate anode furnace and casting wheels capacity to treat the production from the treatment of 650,000 tpa concentrate (approximately 650 tpd of new copper), but it will be necessary to rehabilitate the currently disused holding furnace to improve the interface between the converters and anode sections. The casting section will be modernized and refurbished to improve the productivity of the existing casting wheels.

3.7 Sulphuric Acid Plant

The acid plant will be of single contact configuration and designed to process all the Isasmelt furnace offgas with the furnace operating at 850,000 tpa of concentrates. The treatment of 850,000 tpa concentrates equates to an offgas flow of 80,000 Nm³/hr of wet gas at a sulphur dioxide concentration in excess of 13% by volume. At the lower treatment rate of 650,000 tpa concentrates, the sulphur dioxide concentration will be lower at approximately 11% SO₂, but

the volumetric flowrate will remain of a similar magnitude, due to operating the Isasmelt furnace with a reduced oxygen enrichment in lance air.

The acid plant will produce up to 950 tpd sulphuric acid at the 650,000 tpa concentrate treatment rate and up to 1,150 tpd sulphuric acid at the 850,000 tpa concentrate treatment rate with sulphuric acid produced being 98.5% in strength. The sulphur dioxide conversion efficiency of the acid plant will be in excess of 97%. This translates into fixation of 55-59% and 50% of total sulphur dioxide produced for the 650,000 tpa and 850,000 tpa cases respectively. When compared to the current scenario the total sulphur dioxide emissions will reduce by 18% for the 650,000 tpa case, although the concentrate treatment rate will have increased by 51%. By optimising the matte grade to 70% copper for the 650,000 tpa case, sulphur dioxide emissions could decrease further to 28% (equivalent to sulphur dioxide capture of 59-62%) when compared to the existing operation.

The acid plant will consist of the following main processes:

- (a) Gas cooling and cleaning;
- (b) Gas drying and converting;
- (c) Gas absorption;
- (d) Acid storage and loading.

Gas Cooling and Cleaning

The hot and dusty gas exiting the induced draft fan will be scrubbed and cooled in a high efficiency gas cleaning section consisting initially of primary reverse jet scrubbers, where the majority of the dust will be removed. This will ensure that the amount of dust carried over to the converting or contact section of the acid plant is kept to a minimum, thus ensuring reliable operation between planned maintenance shutdowns.

The gas will pass through a packed cooling tower, where further cooling and cleaning will take place. The weak acid circulated over the gas cooling tower

will be cooled in the weak acid coolers. The cooled gas will then be further scrubbed in a two stage secondary scrubber. There will be a process water make-up to the secondary scrubber and an effluent bleed off from the primary scrubber liquor circuit to the packed stripping tower.

Gas Drying, Converting and Adsorption

Acid mist droplets and remaining dust particles will be removed from the gas stream in two stages of electrostatic mist precipitators. The mist precipitators will be flushed periodically for cleaning purposes with weak acid taken from the gas cooling tower circuit. The precipitator insulator compartments will be purged with heated air. Fog sprays will be installed in the ducting between the primary and secondary mist precipitators to humidify the gas. Water filled U-seals will be provided in the gas ducting at the inlet and outlet of each individual precipitator for isolation purposes.

A water filled safety suction seal will protect the plant, up to this point, from excessive suction.

A dilution air inlet, filled with a filter to remove atmospheric dust, will be provided at the inlet to the drying tower.

The cool, clean gas will pass through the packed drying tower, where the water vapour will be removed by the circulating sulphuric acid. The gas will pass through a mesh pad mist eliminator before leaving the drying tower.

This section of the plant will operate under suction from the SO₂ blower. The blower casing will be cast iron and the impellor alloy steel for optimum corrosion resistance. Inlet guide vanes will regulate the gas flow rate.

The dry gas will leave the SO₂ blower under pressure and will be heated in the shell side of the cold and hot heat exchangers respectively, before entering the first pass of the three pass converter, where the SO₂ will be converted to SO₃ utilising vanadium pentoxide catalyst. By-pass ducts will be provided around the heat exchangers for temperature control purposes.

The hot gas leaving the converter first catalyst pass will be cooled in the tube side of the hot heat exchanger before entering the converter second catalyst pass. The hot gas leaving the converter second catalyst pass will be cooled in the tube side of the air cooled gas cooler before entering the converter third catalyst pass. The hot gas leaving the converter third catalyst pass will be cooled firstly in the tube side of the cold heat exchanger and secondly in the air cooled SO₃ cooler before passing through the packed absorption tower, where the SO₃ will be removed from the gas stream by the circulating sulphuric acid. The conversion of SO₂ to SO₃ in the three-pass converter will be in excess of 97%.

The depleted gas leaving the absorption tower will then pass through candle type mist eliminators in the top of the absorption tower, before exiting to atmosphere up the stack.

Ancillary Systems

A diesel fired oil burner will be provided to preheat the catalyst in the converter to strike temperature prior to the introduction of SO₂ gas. During the pre-heating, air will be drawn into the plant through the dilution air inlet before the drying tower.

The drying and absorption towers will each be provided with an acid circulation tank, acid circulating pumps and an anodically protected acid cooler. The acid produced will be further cooled in the product acid cooler before being pumped to two acid storage tanks, each of a nominal capacity of 7,500 tonnes of sulphuric acid. A rail and road, acid out-loading facility will be provided.

A water cooling tower will supply cooling water to the weak acid coolers, the SO₂ blower oil cooler, the drying and absorption acid circulating coolers and the product acid cooler.

The following liquid effluents will be produced by the plant:

- Gas scrubbing and cooling plant purge which will be a continuous flow of acidic effluent.
- Water cooling tower side stream filter backwash which will be an intermittent flow of “industrial” water.
- Weak acid, strong acid, and acid storage banded area effluents which will be intermittent flows of rainwater, wash down water and acidic spill water.

The effluents will be collected and pumped into an effluent tank for neutralization prior to being pumped to an appropriate disposal facility e.g. the tailings thickener at the concentrator.

4.0 REGIONAL OVERVIEW

4.1 Regional Setting

The Zambian Copperbelt of which Mufulira Mine is a part, generally lies within the Kafue river drainage system which has a well developed dendritic drainage pattern and a gently undulating topography of between elevations of 1,250 and 1,400 meters. A regional topographic map of the project area is as shown in Figure 1. The Kafue river is the principal surface water body on the Copperbelt. The headwaters of the Kafue river occur at the north-western end of the Copperbelt, close to the Democratic Republic of Congo and about 150 kilometers from Mufulira. Anticlinal axes control the course of the Kafue river through the Copperbelt. The east-west reach of the Kafue river north of Nchanga follows an anticline axis north of the Nchanga Syncline. From the confluence with the Muliashi stream to as far south as Kitwe, it is on or close to the axis of the Kafue Anticline. Similarly the north-south stretch from Kitwe southwards follows the Chifita-Mokobo Culmination.

Various tributaries of the Kafue river cut through synclines and basins of the Katanga system and generally flow over deeply weathered Carbonate Formations, especially the Kakontwe Limestone. Most tributaries rise in grass treeless dambos which are wet or swampy during the rain season but may dry out during the dry season.

Other major mining towns on the Copperbelt apart from Mufulira where Mufulira smelter is located are Luanshya, Ndola, Kalulushi, Kitwe, Chambishi, Chingola and Chililabomwe. These towns are connected by trunk road and railway systems. There is an international airport at Ndola and a domestic airport at Kalulushi located about 65km and 40km from Mufulira respectively.

A regional plan showing the location of Mufulira Mine licence area is shown in Figure 2. The Mufulira Mine licence area covers 19,101 ha. The area is drained by a number of streams and rivers which eventually discharge into the Kafue river located about 15 km to the west of the mine.

There is a well-developed infrastructure on the mine to support this project. Apart from the underground mine there is a concentrator, a smelter, a refinery and associated engineering workshops. Some of the support facilities will however require upgrading in order to be more effective. Fig. 3 shows the general layout of the project area and vicinity.

4.2 Regional Climate

A permanent meteorological station within the Copperbelt is located at Ndola about 65km from Mufulira. The predominant wind direction is from the north-west and south-east. The mean wind speed ranges from 2.4 m/s and 2.9 m/s, however wind gusts can reach 30 m/s.

There are three distinct seasons namely:

Cold and dry season; May to July

Hot and dry season; August to October and

Wet season; November to April

The mean annual precipitation at Mufulira is in the order of 1,300 mm. This relatively high precipitation occurs principally in the summer months, between November and March and falls mainly as intense thunderstorms. The 30-year maximum 24-hour precipitation has been calculated as 126 mm and the 100 year maximum 24-hour event as 149 mm. Generally the rainfall on the Copperbelt has low variability. To put the situation in perspective, data from long standing records at Kafironda Station located about 10km from Mufulira Mine is given in the table below

Table 4.2: Mean monthly rainfall and evaporation from Kafironda Weather Station

Month	Mean Monthly Rainfall (mm)	Mean Monthly Evaporation (mm)
January	292	144
February	234	134
March	221	130
April	76	125
May	5	163
June	0	147
July	0	171
August	1	220
September	4	253
October	30	257
November	155	178
December	323	150
Annual Total	1,341	2,072

As can be seen from the above table, on average annual evaporation exceeds rainfall for two thirds of the year, i.e. April to November. The temperature data available at Kafironda Meteorological Station show that the mean annual temperature is 19.4°C. and the mean minimum and the mean

maximum temperatures are 11.3°C and 27.8°C respectively. The absolute maximum temperature is 36.3°C and the absolute minimum temperature is –3.8°C.

Incidences of Extreme Weather Conditions

Incidences of extreme weather conditions are rare. These include high winds and floods.

4.3 Soils

The red lateritic soils of the Copperbelt generally have sandy top soils overlaying a more loamy clayed subsoil. The soil profile is thickest over the high ground and gradually thins towards the dambos and stream valleys. These soils are susceptible to erosion by rainwater if soil conservation practices are not used. Because of the high rainfall in the Copperbelt, the soils are strongly leached, have a low reserve of plant nutrients and low base saturation. The soils are acidic with pH ranging from 4.0 to 5.5 with no discernable change in pH to a depth of about 3 m. Past studies findings are summarized in table 3.3 below.

Table 4.3: Mufulira Soil Characteristics

Sample	Colour	Physical Characteristics					
		Texture	% Clay	%Silt	% Coarse Sand	% Fine Sand	pH
1	10YR 5/2	Clay Sand	5.6	6.7	76	11.7	4.9
2	10YR 7/6	Heavy Clay Sand	12.8	37.2	5	45	5.2
3	10YR 7/4	Clay Sand	10.2	9.9	21.7	58.2	5.1

Mendelsohn F (1961) divides the Mufulira sub region soils into three main layers namely:

(a) Upper Soil Layer

This layer is thickest (550 – 610 cm) over the Upper dolomite and the porous quartzites and grits of the Footwall formation. Over the Mwashia and Kundelungu shale this layer ranges from 0 to 305 cm, and over the Basement it ranges from 370 to 460 cm in thickness.

In the Mufulira and Butondo stream valleys the upper soil has been removed and the valleys are partly filled with alluvial clays and clayey soils. At the edges of the stream dambos the upper soil becomes more clayey.

(b) Rubble Layer

This layer ranges in texture from a fine nodular aggregate of iron oxide concretions to a coarse agglomeration of fragments of the underlying rock. This layer is however, absent in the deeply incised Mufulira and Butondo stream valleys.

(c) Lower Soil Layer

The lower soil under the rubble layer ranges in thickness from a few centimeters over the more resistant Basement rocks and over quartzites and shales, to more than 610cm over the Upper Roan dolomites. Partly decomposed fragments of the underlying rock become more numerous at depth and merge with the partly decomposed rock itself.

Pre-mining Land Use

There is no data on pre-mining land use activities. Industrial activities in the general project area, has been on going since the 1930s.

4.4 Natural Vegetation

The regional tree vegetation is predominantly of the Miombo woodland family with elephant grass (*Pennisetum purpureum*) being the dominant grass type. The surface area involved in the project is small, located within the plant site boundaries and largely within the existing smelter complex.

4.5 Animal Life

There is little animal life in the project area vicinity presumably due to past and ongoing mining activities, and human disturbance of the habitat. No rare or endangered animals have been noted in the project vicinity, let alone in the rest of the mine licence area.

4.6 Surface Water

Mufulira Mine licence area is principally drained by Mufulira, Luansobe, Butondo, Mupambe and Kansuswa streams whose water eventually end up in the Kafue river located about 15 km to the west of Mufulira Smelter. The streams are located 1 km to 5 km from the project area. The streams and the Kafue river are monitored regularly for impact of discharges from ongoing mining activities. Wastewater leaving the Smelter complex acid plant will be neutralized and discharged to the environment through the Concentrator tailings disposal system.

4.7 Ground Water

Infiltration from precipitation into groundwater system has been estimated by past studies at 7 to 10% of the average annual precipitation. Several of the local streams cross outcrops of water bearing strata. However due to the limited thickness of these strata, the recharge potential from the streams is considered not substantial.

Groundwater other than that from mine dewatering is monitored from a number of boreholes that were sunk as part of the global EIS study in 2000/2001. The quality of the boreholes water has been consistently acceptable when compared to wastewater limits. However boreholes located outside the plant site boundaries have all but one located at the active tailings dump, been vandalized by trespassers.

There are no known groundwater users in the Mine License Area or the immediate surroundings. However a portion of mine dewatering water pumped to surface is treated by another company and supplied to the townships as potable water. The quality of this water is analysed by Mopani analytical laboratory on a daily basis for pH and Total Dissolved solids, on a weekly basis for pH, total hardness, suspended solids and total dissolved solids and on a monthly basis for pH, Cl⁻, Cu, total hardness, Fe, Mn, Na, SO₄, total dissolved solids and Zn.

4.8 Air Quality

Significant air pollution at Mufulira results from gaseous emissions from the Smelter. Other sources of air pollution but of lesser significance are bare surfaces on the plant site and tailings dumps.

The project area i.e. the plant site has residential areas in its vicinity stretching in a semi circular manner from the eastern through the southern to the western side of the plant site, with some houses less than 500m from the plant site fence. The residences most affected by plant site emissions are those on the western side (Kankoyo Township), the prevailing wind direction. However in the rain season when moist Congo air blows from the north-west even the eastern parts of the town get affected by the plant site gaseous emissions.

There will be no radioactive emissions.

4.9 Noise

Noise generation will largely be localised to the plant site. Noise sources will mainly be air blowers and fans. The work environment noise levels will be significantly reduced as there will be no requirement for external cooling fans (the major contributor to noise in the smelter) with the change to Isasmelt technology. Significant but intermittent noise may arise due to increased traffic of road trucks and trains bringing in foreign concentrates to the smelter and transporting sulphuric acid and copper out of Mufulira.

4.10 Sites of Archaeological and Cultural Interest

There are no sites of archaeological and cultural interest in the area involved in the project. Archaeological sites identified in the global study of the Mufulira Mine licence area are far away from this project's influence.

4.11 Sensitive Landscapes

There are no sensitive landscapes in the area of the project.

4.12 Visual Impacts

The project area is located within the existing Mufulira plant site and has therefore a visual aspect of an industrial area. Project components will be located within the Mopani property and mostly inside the existing plant site boundaries. New facilities which will be constructed to support this project will therefore blend into the existing visual outlook without causing significant change in the landscape.

4.13 Regional Social-Economic Structure

The major activity on the Copperbelt is mining and majority of people in formal employment work on the mines. A significant number of people are also employed by local companies, that mainly deal in activities related to the

mining industry, i.e. provision of equipment spares, labour hire and such other support services. Those not employed by these businesses are mainly in government ministries or its agencies or are in the informal sector of the economy. The major activities in the informal sector are subsistence farming, buying and selling of various goods and services and charcoal burning. The driving force behind these informal economic activities is the mining industry's generated income.

The year 2000 census of population showed that unemployment for males dramatically increased from 14% in 1990 to 24% in 2000, and this can be attributed to the labour shocks brought about by the privatisation of the mining industry, with the industry refocusing on the core business so as to quickly return to profitability. The increase in unemployment may also have triggered the observed net increase in migration of 6% from the region in the period 1990 to 2000.

There are a few commercial farmers on the Copperbelt, mostly in cattle ranching for beef and milk, crop farming (mainly maize), poultry and horticultural. With the right type of investment and management agriculture has potential for expansion in the region.

Mufulira Sub – region

The local economy is strongly supported by Mufulira mine of Mopani Copper Mines Plc. Other economic sectors rely heavily on the mine for patronage. In addition to the other industries that are supportive of mining activity, the Mufulira Municipal Council represents another relatively major employer within Mufulira. Informal economic activities are mainly subsistence farming, charcoal burning and buying and selling.

At the last national population census carried out in 2000, the population of Mufulira was estimated at 153,000 and the mining community households accounted for about 14% of the district's population. Mufulira district accounts for about 9.6% of the Copperbelt's province population. There will be no

resettlement of people to pave way for project implementation. It is not expected that project implementation will create an influx of new residents into Mufulira, as the project is a relatively low labour operation and will largely depend on the already existing idle labour force in the town.

An information sharing meeting on this project and the *in situ* leach project for which approval has already been granted was held with community representatives and issues raised in that meeting are detailed in appendix B.

4.14 Interested and Affected Parties

Other than relevant government departments and regulatory agencies, the other key interested and affected parties are the following:

- Mufulira townships residents
- Mufulira local council
- Zambia Railways
- Mine Workers Union of Zambia
- ZCCM-IH
- Copperbelt Energy Corporation
- Local Religious and Political Organisations
- NGOs active in the district
- Local companies resident in Mufulira town
- Other copper mining companies in Zambia

5.0 MINE SITE CHARACTERIZATION

5.1 General

Mufulira mine is a mining complex comprising the underground mine, the Smelter, the Concentrator, the Refinery and associated engineering and other support facilities. The mine licence area covers 19,101 ha. Presently, the major discharges into the environment are sulphur dioxide from the Smelter,

waste rock from mining operations, tailings and effluent water from the Concentrator. Mine dewatering water is largely used in the concentrator with a portion supplied to AHC-MMS who process it into potable water. The major existing environmental issue of concern is the continuing discharge of sulphur dioxide from the smelter. Currently about 94,000 tonnes of sulphur dioxide is vented annually from the smelter.

5.2 Concentrates Availability

MCM production forecasts indicate a relatively consistent production of approximately 400,000 tpa concentrate from MCM mines (Nkana and Mufulira concentrators). Initially, this production would be supplemented by the treatment of malachite sourced from the DRC and through purchase and toll treatment of small quantities of concentrates from regional companies (i.e. Chibuluma and KCM).

Discussion with Zambia's mining industry management and Glencore trading personnel indicated that by 2005, the potential quantity of concentrate available for purchase or toll treatment in the immediate region would be sufficient to fill the capacity of an 850,000 tpa concentrate smelter. The companies included in Table 5.2 below currently export concentrates to alternative smelters overseas or in South Africa, or require a smelting facility to process concentrates after their mine / project development has been completed.

Table: 5.2 Foreign Concentrates Requiring Smelting Facilities.

Company	Operation	Concentrates Tonnes/annum	Available from
Metorex	Chibuluma West / South	24,000	Present
Anvil	Dikulushi	40,000	Present
J & W	Baluba	78,000	mid-2004

NFC Africa	Chambishi	120,000	mid-2004
First Quantum	Kansanshi	180,000	early 2005
Total		442,000	

Although there is some uncertainty about the eventual project production rates, at each of the above locations, there is a high degree of confidence that there will be 250,000 tpa of concentrates available for treatment by 2006, and this figure could well increase to around 500,000 tpa or more if potential arisings from the north-western province of Zambia or the DRC are included. Additionally, there remains the probability that concentrates will be made available by KCM for purchase or toll treatment should KCM mine production exceed the Nkana smelter capacity of 350,000 to 400,000 tpa concentrate.

After considering the projected availability of concentrate in the immediate region and the existing cumulative smelting capacity of the Mufulira and Nkana smelter, it is evident that the end of campaign of the existing electric furnace represents a strategically valuable opportunity to install a smelter with a capacity of 850,000 tpa which will initially be operated at 650,000 tpa.

5.3 Smelting Alternatives Considered

In evaluating the various smelting alternatives the following three points were kept in focus:

- (a) Increasing power costs in Zambia and recent global developments and applications of more efficient high intensity smelting technology;
- (b) Potential increase in concentrate availability above the 500,000 tpa level from new mine developments in Zambia. 500,000 tpa is the maximum throughput that commercially proven electric furnace technology has been able to process adequately.

(c) The legislation requirement for sulphur fixation at the Mufulira Smelter and the disadvantages of low sulphur dioxide tenor from the electric furnace process offgas.

Other than rebuilding the electric furnace to an increased capacity, other smelting options were evaluated for installation at Mufulira as detailed below. These alternatives were predominantly high intensity oxygen smelting technologies, namely;

Outokumpu Flash Furnace Technology

Mitsubishi Continuous Smelting Process

Noranda/CMT Reactor Technology

KHD Contop Reactor Technology

Top Submerged Lance (TSL) Technology

Electric Furnace

Technology suppliers have advised that electric furnaces with capacity to treat in excess of 500,000 tpa copper concentrate (the minimum treatment rate for the Mufulira smelter) have not been constructed and as such constitute an unacceptable high risk to MCM. Further treatment of the projected maximum available concentrate tonnage of 850,000 tpa would require two parallel electric furnaces, which based on the capital requirement for a single new electric furnace would be an uneconomic option.

Outokumpu Flash Furnace Technology

Outokumpu Flash Furnace technology is widely used throughout the world in copper and nickel smelting applications. However, most recent applications are in the first world countries where precision engineering capability and extensive provision for technical support is readily available, e.g. Rio Tinto's Kennecott Utah Copper Corporation (KUCC) smelter in the USA and OKO / Boliden's Ronnskjeur smelter in Sweden. This technology has a high capital

requirement (e.g. US\$880M for the complete KUCC smelting complex) and is renowned for being difficult to commission to nameplate capacity within an eighteen-month duration, the target for this upgrade project.

An alternative approach using flash smelting technology which was also considered is direct-to-blister (DTB) flash smelting, utilising the high copper content of the Mufulira concentrate to produce blister copper in a single furnace. However, the current life-of-mine concentrate availability for the Mufulira Smelter is not suitable for DTB smelting as the Mufulira Mine is scheduled to exhaust reserves by 2014 and the replacement concentrates will be low grade in respect to Mufulira concentrate and would result in high reticulation of furnace slag through a flotation circuit to recover copper in slag.

As such, Flash Furnace technology was excluded on the basis of technical complexity for the Zambian environment, not being well suited to the retrofit nature of the Mufulira project and high capital requirement.

Mitsubishi Continuous Smelting Process

The Mitsubishi Continuous Smelting process was first established in Japan but has expanded to include commercial operations in Canada, Indonesia and Australia, of which the latter has now closed. As with flash furnace technology, the Mitsubishi process has a significant capital requirement and engineering support services normally associated with western world economies. Additionally, there is no commercial template for a Mitsubishi system retrofit into a similar operation to Mufulira and as stated above, the only integration of Mitsubishi technology into an existing 'brownfield' smelting site (i.e. the Mitsubishi Converter at Port Kembla Copper, Australia) was not successful.

The technology was therefore excluded on the basis of technical complexity for the Zambian environment, not being well suited to the retrofit nature of the Mufulira project and high capital requirement.

Noranda / CMT Reactor Technology

The CMT horizontal reactor was initially developed at Codelco El Teniente division and is widely accepted in Chile and more recently Mexico. The Nkana smelter in Zambia has the only CMT reactor operating outside Latin America and the operability of the Nkana smelter since the CMT was installed in 1994 has been problematic and not a basis for an endorsement of CMT reactor development in Zambia. Noranda reactors, which are similar to CMT reactors, were developed by Noranda in Canada and have had limited acceptance as primary smelting technology with the exception of three operations in Chile, Australia and China.

Both the CMT horizontal reactor and the Noranda reactor were excluded on the basis of the poor performance of the CMT reactor in the Zambian environment and the relatively inexperienced technical resources readily available.

KHD Contop Reactor Technology

KHD Contop Reactor technology is a high intensity oxygen reactor that is normally retrofitted to a reverberatory furnace. The technology is not widely accepted and in operation it has not performed well, being shut down at Palabora, South Africa and Asarco El Paso, USA. The technology has not adequately proven itself and was therefore excluded.

Top Submerged Lance (TSL) Technology

Top Submerged Lance (TSL) technology was considered to be a viable alternative to electric furnace smelting based on preliminary data and marketing-level studies provided by two technology suppliers (Xstrata Technology marketing the Isasmelt furnace and Ausmelt Technology marketing the Ausmelt furnace).

The TSL smelting process was first commercialised in Australia in the late 1980's and has recently been gaining increasing acceptance in a wide range of applications in such diverse countries as USA, Belgium, Germany, India, China, South Korea, Peru, Malaysia, South Africa, Zimbabwe and Namibia. The TSL smelting process relies on a vertical lance inside a vertical cylindrical smelting vessel. The tip of the lance is submerged in the molten furnace charge, and air, oxygen and/or fuel are injected via the lance, causing extremely rapid smelting reactions. The advantages of the process include:

- compact size and small footprint, easily accommodated in a retrofit as will be the case at Mufulira
- relatively low capital cost
- low operating costs, as much of the energy for smelting is provided by the oxidation of sulphide minerals in the charge
- good containment of offgas, which is of high strength and well suited for acid production
- relative ease of operation.

However, for optimum operation, TSL technology does require a supply of tonnage oxygen, but this permits a considerable degree of flexibility, since the furnace throughput can be increased over a substantial range by simply increasing the degree of oxygen enrichment. TSL technology also requires an auxiliary settling furnace because the TSL furnace bath is too small and highly agitated to permit the effective separation of matte from slag.

After further consideration of the benefits MCM has decided to implement TSL technology, specifically the Isasmelt furnace, for the Mufulira smelter and construct a dedicated acid plant for fixation of sulphur dioxide produced by the Isasmelt furnace.

5.4 Support Facilities

Power supply

The combined power requirement for the new smelting and the associated facilities (oxygen plant, acid plant, etc) will be approximately 31MVA. It is envisaged that the power will be supplied from the existing Kankoyo and Mufulira substations after being upgraded. Initially the Isasmelt furnace and the existing electric furnace will be run in parallel. Once the Isasmelt furnace is running at design capacity the existing electric furnace will be shutdown, resulting in power requirements reducing to levels similar to the current situation.

Water Supply

Process water will be obtained from that which is currently being pumped to surface as mine dewatering. Domestic water will be tapped from existing plant site system fed by AHC-MMS water treatment plant located within the mine plant site boundaries.

Compressed Air

New air compressors will be installed to meet the requirements of the new smelting equipment. There will be no impact on existing users.

Roads, railways, etc

The existing road and railway infrastructure will be used for transporting raw materials and finished products.

Housing

No new housing units will be constructed. Workers will come from already existing townships.

Mine Disposal Sites

Existing disposal sites for slag will be used. Acidic effluent will be neutralized and disposed through the Concentrator tailings thickener.

Domestic and Industrial Waste Disposal sites

Existing disposal sites will be used for the project. Disposal of hazardous waste will be as per legislation and MCM procedure on waste management.

5.5 Alternatives to Stream/river Diversion

There will be no stream or river diversion

5.6 Final Products

The final products will be:

(a) Copper anodes, which will be sent to the Mufulira refinery for processing into copper cathode which will be sold through the existing Mopani copper market. Cathode copper production at the 650,000 tpa concentrate treatment rate is expected to be 217,000 tpa.

(b) Sulphuric acid which will be partially used inhouse on various Mopani operations (*In situ* and Heap leaching projects, Cobalt plant, Refinery, etc) with the excess being sold to other users. Acid production will initially be at 298,000 tpa and will increase to 336,000 tpa at concentrate throughput of 850,000 tpa.

(c) Sulphur dioxide from the converters, which will be vented to the atmosphere.

(d) Slag from the MSEF which will be discarded on existing slag dumps.

5.7 Project Labour Force

An additional 800 to 1,000 people will be employed during the construction phase of the project in 2005. There will be no change in labour force strength from the current smelter labour force of 570 employees during the operational phase, as the reduced labour requirements for the Isasmelt furnace will be offset by labour requirements for the acid and oxygen plants. However there will be substantial retraining of the current labour force to meet the skills demanded by the new plant facilities. A significant part of the training will take place at comparable facilities in Australia and Philippines.

5.8 Project Expenditure

The capital cost of the project is expected to be approximately \$110 million.

5.9 Land use post rehabilitation

Most likely not all infrastructure units will be demolished on cessation of operations both for this project and those for currently ongoing activities. Some facilities are likely to be sold or passed on to third parties for use post mine life. Facilities like engineering workshops and office blocks fit into this category of infrastructure with potential for being sold off. Facilities that will not be of any economic or social value for the town of Mufulira will be demolished and the sites rehabilitated to enhance the aesthetic appearance of the area.

6.0 PROJECT MOTIVATION

The existing electric furnace is coming to the end of its campaign life cycle in 2005 and it is therefore necessary to either rebuild it or replace it with some other type of a primary smelting vessel to guarantee continued copper smelting at Mufulira Smelter. The continued use of an electric furnace (a rebuild or a new expanded unit) will only be able to achieve a throughput of 500,000 tpa. However, Zambia's copper industry management is projecting copper concentrate availability beyond 2006 of 850,000 tpa.

Electric furnace technology has not yet commercially developed to a level where concentrates in excess of 500,000 tpa can be treated in a single vessel. The installation of an Isasmelt furnace will provide MCM with the flexibility to treat up to 850,000 tpa from the projected commissioning capacity of 650,000 tpa for the primary smelting vessel.

Smelter operating cost are projected to drop from US\$64 to US\$54 and US\$51 per tonne of concentrate processed at 650,000tpa and 850,000tpa throughputs respectively.

Further, the technology change will enable MCM to construct an acid plant for fixation of in excess of 97% of the sulphur dioxide in the Isasmelt furnace offgas. This translates into fixation of 55% to 59% of the total sulphur dioxide to be produced by the new configuration at the smelter (at the 650,000 tpa rate)

MCM will produce its own sulphuric acid at a much reduced cost when compared to purchased acid. Currently MCM purchases acid for use at the Nkana Cobalt Plant and Mufulira Refinery at a cost of US\$155 per tonne. The cost of producing acid at the new acid plant is estimated at US\$25 per tonne of acid.

Acid consumption within MCM is expected to increase from 100 tpd to 300 tpd with the coming on line of the *in situ* leach and heap leach projects at Mufulira and Nkana Mines respectively. Excess acid will be sold to other mines on the Copperbelt and to new copper projects in the North-western province.

The fixation of sulphur dioxide produced by the Isasmelt furnace will set MCM on a firm foundation, essential for eventually meeting its obligations to complying with Zambia's environmental legislation in respect of sulphur dioxide and particulates emissions from the smelter. When compared to the current scenario sulphur dioxide emissions will reduce by 18% at the initial throughput of 650,000 tpa although the concentrate treatment rate will have

gone up by 51%. Optimising the matte grade to 70% copper is expected to reduce the emissions by 28% compared to the current operation.

There is potential to increase the sulphur dioxide capture level at a later stage by expanding the acid plant to facilitate fixation of converters offgas. However this is subject to a further evaluation of the sulphuric acid market and this evaluation is scheduled for 2007/2008.

Implementation of this smelter upgrade project will create new employment opportunities, preserve jobs in the smelter and also ensure MCM continued positive contribution to economic activities at Mufulira in particular.

7.0 THE “NO PROJECT IMPLEMENTATION ” OPTION

The no project implementation option in this case, means rebuilding the electric furnace at the end of its campaign life in 2005 to current existing operating parameters. This scenario would result in the following:

- MCM's smelting process would not improve in respect of capacity, efficiencies and environmental performance, parameters which MCM is obliged to improve as per the Development Agreement.
- MCM would lose the opportunity to improve its bottom line through cost reduction at the smelter and by producing its own acid for the heap leach and *in situ* leach projects which are due to come on line during 2004. The cost of bought in acid is more than six (6) times the cost of producing own acid. Acid cost will be the single major operating cost for these two projects and will therefore determine the long-term viability of these projects.
- The working capital requirements for rebuilding the existing electric furnace would be extremely disadvantageous to MCM. Effectively, MCM would not have a smelting capability for the five to six months duration of the smelter rebuild during which time MCM would either have to stockpile MCM concentrates (approximately 180,000 t) or

transport concentrates for toll treatment at alternative international smelting facilities.

- Temporary (during construction phase) and permanent jobs will be lost due to non-implementation of this project.
- The potential to continue providing toll treatment facilities not only to the Zambian copper industry, but to copper mines in the neighbouring Congo DR may be lost due to constrained smelting capacity.

8.0 ENVIRONMENTAL ISSUES

The main environmental issue of concern in respect of this project is the sulphur dioxide emissions. The current smelter operation discharges all process offgas through the electric furnace stack and the converter stacks. The project will include construction of an acid plant for the fixation of sulphur dioxide produced by the Isasmelt furnace and thereby control overall sulphur dioxide emissions to the atmosphere.

8.1 Land and Water Bodies which may be Affected

The evaluation process for land and water bodies that may be affected was based on the premise that an environmental exposure pathway normally consists of four elements namely:

- (a) A contamination source
- (b) A retention or transport medium
- (c) A point of potential contact with contaminated medium
- (d) An exposure route at the point of contact

Land which may be significantly affected by the project operations is that on which the project components will be located on and the slag disposal dump sites.

Project site groundwater may be affected by liquor seepage. The nearest surface water source which may be affected, is the Mufulira stream to the west of the project area. Site surface run off including storm drains discharges eventually end up in the Mufulira stream.

8.2 Potential Significant Environmental Impacts due to Project Implementation and Operation

Metallurgical Operations

- (i) Air pollution due to venting of sulphur dioxide.
- (ii) Air pollution due to dust carry over in gaseous emissions.
- (iii) Dust from material stockpiles / storage sheds.
- (iv) Noise due to construction and operation of project facilities.
- (v) Surface water contamination by acidic spills and discharges into storm drains.
- (vi) Groundwater contamination by seepage from storage tanks areas
- (vii) Human exposure to hazardous substances.

Other

- (i) Employment opportunities
- (ii) Land use conflict
- (iii) Water resources availability
- (iv) Local /national economy

8.3 Environmental Mitigation and Monitoring programme

Metallurgical Operations

- (i) Air pollution due to venting of sulphur dioxide

Compared to the existing scenario where all the sulphur dioxide produced is vented, the project will allow for fixation of 55% to 59% of the total sulphur

dioxide produced through the fixation of Isasmelt furnace offgas by the new sulphuric acid plant. Only sulphur dioxide from the converters will be vented. Fugitive sulphur dioxide emissions will be eliminated in the new Isasmelt furnace and MSEF set up. The reduction in sulphur dioxide vented will be 18% when compared to the current operation. Optimising the matte grade may further reduce sulphur emissions to 28% compared to the current operation.

On going sulphur dioxide monitoring on the plant site and in the residential areas will continue. The meteorological station is being refurbished to facilitate collection of weather information data for modelling of sulphur dioxide dispersion.

(ii) Air pollution due to dust in gaseous emissions

The electrostatic precipitator and the evaporative cooler will capture dust entrained in Isasmelt offgas for recycling to process. Any dust not captured in the electrostatic precipitator will be collected in the acid plant gas cleaning section (not emitted to atmosphere). Compared to the current situation there will be a significant reduction in dust emissions. However the current stack emissions dust monitoring will continue

(iii) Dust from material stockpiles / storage sheds

The concentrate shed with a nominal capacity of 30,000 tonnes will be fully enclosed. Concentrates will be received in moist form with moisture content of between 8 and 10% and will be offloaded through hopper offloading facilities, with rail wagons using the tippler station and road trucks using a purpose built offloading facility.

Coal for use will be purchased in pellet form (with sizes ranging from 6 mm to 38 mm) and will be used in this form to minimize potential for dust generation.

The current on going monitoring of dust in the smelter will continue and will include the new facilities.

(iv) Noise due to construction and operation of project facilities

Workers will be issued with appropriate personal protective equipment at all stages of the project, and in addition the design and selecting of construction materials will take into account use of materials with potential for noise reduction during the operation phase.

(v) Surface water contamination by acidic spills and other discharges into storm drains

All acid storage tanks will be in a bund wall enclosure. The enclosure will have a capacity of 110% by volume that of the largest tank in the enclosure. Acid pipelines will as far as is practical be above ground for early detection of leaks and hence repairs and neutralization of leaked acid and disposal. Acidic effluent generated by the process will be neutralized for disposal through the concentrator tailings disposal system to the tailings dump.

An appropriate bund wall will be constructed at the acid-loading bay for spills containment.

(vi) Groundwater contamination by acidic spills

Enclosures floors will be lined with impermeable material. The acid loading bay floor will also be lined with impermeable material to prevent seepage of acid into the ground.

One or two groundwater monitoring boreholes will be sunk in the vicinity of the storage tanks and the loading bay.

(vii) Human exposure to hazardous substances

A procedure incorporating storage, handling and transportation of sulphuric acid will be developed. A similar procedure for the management of the catalyst to be used in the acid plant will also be developed by taking into account details contained in the substance material safety data sheets.

In respect of foreign concentrates supplied for treatment at the smelter, there is an existing procedure used to screen the materials to ensure that they are not radioactive. Materials showing above limit levels of radioactivity will not be accepted for processing through the smelter.

Other

(i) Employment opportunities

It is anticipated that an additional 800 to 1,000 people will be employed during the construction phase of the project. With the exception of components of the project where specialist skills will be required, most of the contract labour requirement will be sourced within Mufulira. There will be no significant increase in labour from the current 570 smelter employees during the operation phase. However, certain employees within the smelter will be retrained and redeployed to take up positions in operations of the new facilities.

(ii) Land use conflict

There will be no land use conflict with the local community as the project facilities will all be located within the existing plant site boundaries.

(iii) Water resource availability

The project water requirements will be met by water currently being pumped to surface for dewatering the underground workings. The quantity, 110,000 m³

per day of water is more than adequate to meet the needs of the whole mine operations.

(iv) Local / national economy

The local economy is largely dependent on the mine for its sustenance and patronage. This project will have a significant positive impact on the local economy.

At the national level the mining industry still accounts for the bulk of the country's foreign exchange earnings. This project will provide an increased capacity for treatment of not only MCM concentrates but also materials from other operators within the Zambian mining industry. At full production it is expected that the project will put in excess of 295,000 tonnes of cathode copper on the international market and thereby significantly increase the country's foreign exchange earnings.

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